



I have a good working knowledge of English and German, and I hereby certify that the attached document is an accurate translation of German Patent Application No. 10261309.5 filed December 27, 2002.

April 2, 2008

A handwritten signature in black ink, appearing to read "Thomas Maier".

Dr. Thomas Maier

Description

Laser diode component and electronic circuit arrangement comprising a plurality of laser diode bars
5 connected up in series with one another

The invention relates to a laser diode component according to the preamble of patent claim 1 and an electronic circuit arrangement in accordance with the
10 preamble of patent claim 11. It relates in particular to a laser diode component and to a circuit arrangement comprising one or a plurality of high-power laser diode bars.

15 Failure of a laser diode bar may give rise to the interruption of the current flow via the laser diode bar. In a circuit arrangement comprising a plurality of laser diode bars or laser diode bar modules connected up in series with one another this leads to
20 the complete failure of all the laser diode bars or modules of the affected series. In order to eliminate the failure, it has been customary hitherto to exchange the entire series with the failed laser diode bar.

25 The present invention is based on the object of providing a laser diode bar and a circuit arrangement in which failure of an individual laser diode bar or module does not give rise to the complete failure of the entire series of laser diode bars or modules.

30 This object is achieved by means of a laser diode bar having the features of patent claim 1 and by means of a circuit arrangement having the features of patent claim 11.

35 Preferred embodiments and advantageous developments of

the invention are specified in the dependent claims 2 to 10 and 12 to 20.

5 The arrangement according to the invention provides for connecting a bridging element, in particular in the form of a semiconductor component, in parallel with a diode laser such that, in the event of failure of the diode laser resulting in an interruption of the current flow via said laser, the bridging element switches
10 through and short-circuits the failed diode laser. Instead of the semiconductor component, it is also possible to use a mechanical element, for example a relay. The bridging element has to be configured in such a way that it is at high impedance during proper
15 operation of the diode laser and that it switches through in the case of a defective high-impedance diode laser on account of the increased voltage drop and short-circuits the diode laser, so that the remaining diode lasers in a series circuit still remain supplied
20 with current.

A preferred switching element is a diode, in particular an AlGaAs diode, whose diffusion voltage (also called threshold voltage) is higher than the operating voltage
25 of the diode laser. The diffusion voltage is preferably at least 200 mV higher than the operating voltage of the diode laser. This advantageously ensures, on the one hand, a reliable operation of a properly functioning diode laser even in the event of voltage
30 fluctuations and, on the other hand, a reliable switching to the on state in the event of a failure of the associated diode laser.

In a preferred refinement of a laser diode component
35 according to the invention, the diode laser and the associated bridging element are applied on a common

heat sink, the bridging element is fixed on the heat sink by means of a first connecting means and the diode laser is fixed on the heat sink by means of a second connecting means. The melting point of the first
5 connecting means is at a higher temperature than that of the second connecting means. This advantageously avoids the situation in which, when the bridging element is mounted on to the heat sink before the diode laser is mounted, the connection between the bridging
10 element and heat sink is damaged during the mounting of the diode laser. As an alternative, the diode laser and the bridging element can be mounted on the heat sink simultaneously using the same connecting means or using similar connecting means.

15

Preferably, the bridging element is fixed on the heat sink by means of a hard solder and the laser diode bar by means of a soft solder.

20 The heat sink is, for example, a metallic cooling body or a metal carrier provided with a microchannel cooler structure, through which a cooling liquid is pumped. However, diode laser and bridging elements may also be mounted on to a common thermally conductive leadframe,
25 which ensures a sufficient dissipation of heat from the diode laser.

In addition to the application of the arrangement according to the invention in the case of laser diode
30 bars, the principle on which the invention is based can also be used in other devices and circuit arrangements in which a plurality of electronic components are connected in series and a bridging of a defective electronic component would lead to a total failure of
35 the entire device or the entire circuit arrangement or a substantial part of the circuit arrangement.

Therefore, it is expressly pointed out that such devices and circuit arrangements are also associated with the invention.

5 Further advantageous refinements and developments of the laser diode component according to the invention and of the circuit arrangement according to the invention emerge from the exemplary embodiment explained below in conjunction with figures 1 and 2, in
10 which:

figure 1 shows a sectional view through the exemplary embodiment,
and
15 figure 2 shows a plan view of the exemplary embodiment.

In the exemplary embodiment, a laser diode bar 1 is mounted together with an AlGaAs diode 2 on a common metallic carrier 3. The laser diode bar 1 is fixed on
20 the carrier 3 by means of a soft solder 4 (for example, indium solder) and the AlGaAs diode 2 is fixed on the carrier 3 by means of a hard solder 5 (for example, AuSn solder). The carrier 3 is a heat sink and in each case constitutes a first electrical connection of the
25 laser diode bar 1 and of the AlGaAs diode 2.

The AlGaAs diode 2 is designed in such a way that its diffusion voltage is approximately 200 mV greater than the operating voltage of the laser diode bar 1.

30 A connection strip 6 spans the laser diode bar 1 and the AlGaAs diode 2 and is electrically conductively connected thereto by means of a metallic solder. The connection strip 6 in each case constitutes a second
35 electrical connection of the laser diode bar 1 and of the AlGaAs diode 2.

In a process for producing such a laser diode component, firstly the AlGaAs diode 2 is fixed on the carrier 3 by means of the hard solder 5. Afterward, the
5 metallic carrier 3 has indium vapor-deposited on it and is thereby prepared for the mounting of the laser diode bar 1. The laser diode bar 1 is subsequently applied by means of soft soldering on the carrier 3. Since the indium soldering is effected at a significantly lower
10 temperature than the hard soldering of the AlGaAs diode 2, there is no risk of the connection between carrier 3 and AlGaAs diode 2 softening again during the mounting of the laser diode bar 1.

15 If, in the case of the arrangement described above, the laser diode bar 1 fails and it consequently no longer permits a current flow, the voltage between cathode (carrier) and anode (connection strip) rises greatly until the parallel diode 2 switches to the on state and
20 short-circuits the laser diode bar 1.

A laser diode component in accordance with the exemplary embodiment has the particular advantage that it is small and integrable.

25 In the case of a circuit arrangement according to the invention comprising laser diode components in accordance with the exemplary embodiment, a plurality of such laser diode components and thus a plurality of
30 laser diode bars are connected up in series with one another.

Instead of the AlGaAs diode 2, it is possible to use a suitable zener diode with regard to the switching
35 voltage, a correspondingly suitable triac (breakover), a plurality of Si diodes connected up in series or a

P2002,1105 DE E

DE 102 61 309.5

- 6 -

mechanical switch/a mechanical fuse (for example a surge arrester, a spring on a solder ball or a bimetallic switch).

- 5 An arrangement using FET technology, SipMOS technology or CoolMOS technology can likewise be employed. A particular advantage of this technology is that an intelligent circuit arrangement with a low power loss can be realized and that the state of the associated
- 10 laser diode can also be identified by remote interrogation. As an alternative, the use of a thyristor, a bipolar transistor, a relay or a manual switch as bridging element is also conceivable.

Patent claims

1. A laser diode component comprising a laser diode bar on which a specific operating voltage is impressed
5 during operation,
characterized in that
a bridging element is connected in parallel with the laser diode bar, which bridging element, when the specific operating voltage is impressed on the
10 associated laser diode bar, is in a current-blocking state and which bridging element switches over to a current-conducting state as soon as the voltage drop across the laser diode bar exceeds the operating voltage by a predefined voltage value.
15
2. The laser diode component as claimed in claim 1, characterized in that
the bridging element changes over to the current-conducting state at a voltage impressed on the bridging
20 element that is at least 200 mV higher than the specific operating voltage of the associated laser diode bar.
3. The laser diode component as claimed in claim 1
25 or 2,
characterized in that
the bridging element has at least one diode which is forward-biased when the specific operating voltage is impressed on the associated laser diode bar and the
30 diffusion voltage of which is at least 200 mV higher than the operating voltage of the associated laser diode bar.
4. The laser diode component as claimed in claim 2
35 or 3,
characterized in that

the bridging element has a diode based on AlGaAs semiconductor material.

5 5. The laser diode component as claimed in claim 2
or 3,
characterized in that
the bridging element has a series circuit comprising a
plurality of diodes.

10 6. The laser diode component as claimed in claim 5,
characterized in that
the series circuit has three Si diodes.

15 7. The laser diode component as claimed in claim 2,
characterized in that
the bridging element has at least one zener diode, the
breakdown voltage of which is at least 200 mV higher
than the operating voltage of the associated laser
diode bar.

20 8. The laser diode component as claimed in claim 2,
characterized in that
the bridging element is a triac, the switching voltage
of which is at least 200 mV higher than the operating
25 voltage of the associated laser diode bar.

9. The laser diode component as claimed in at least
one of claims 1 to 8,
characterized in that
30 each laser diode bar and the associated bridging
element are applied on a common heat sink, in that the
bridging element is fixed on the heat sink by means of
a first connecting means and the laser diode bar is
fixed on the heat sink by means of a second connecting
35 means, and in that the melting point of the first
connecting means is at a higher temperature than that

of the second connecting means.

10. The laser diode component as claimed in claim 9, characterized in that

5 the first connecting means is a hard solder and the second connecting means is a soft solder.

11. A circuit arrangement comprising a plurality of laser diode bars which are connected up in series with one another and on which a specific operating voltage is in each case impressed during operation of the series circuit, characterized in that

15 a bridging element is connected in parallel with each laser diode bar, which bridging element, when the specific operating voltage is impressed on the associated laser diode bar, is in a current-blocking state and which bridging element switches over to a current-conducting state as soon as the voltage drop across the laser diode bar exceeds the operating voltage by a predefined voltage value.

12. The circuit arrangement as claimed in claim 11, characterized in that

25 the bridging element changes over to the current-conducting state at a voltage impressed on the bridging element that is at least 200 mV higher than the operating voltage of the associated laser diode bar.

30 13. The circuit arrangement as claimed in claim 11 or 12,

characterized in that

35 the bridging element has at least one diode which is forward-biased when the specific operating voltage is impressed on the associated laser diode bar and the diffusion voltage of which is at least 200 mV higher

than the operating voltage of the associated laser diode bar.

14. The circuit arrangement as claimed in claim 12
5 or 13,
characterized in that
the bridging element has a diode based on AlGaAs semiconductor material.

10 15. The circuit arrangement as claimed in claim 12
or 13,
characterized in that
the bridging element has a series circuit comprising a
plurality of diodes.

15 16. The circuit arrangement as claimed in claim 15,
characterized in that
the series circuit has three Si diodes.

20 17. The circuit arrangement as claimed in claim 12,
characterized in that
the bridging element has at least one zener diode, the
breakdown voltage of which is at least 200 mV higher
than the operating voltage of the associated laser
25 diode bar.

18. The circuit arrangement as claimed in claim 12,
characterized in that
the bridging element is a triac, the switching voltage
30 of which is at least 200 mV higher than the operating
voltage of the associated laser diode bar.

19. The laser diode component as claimed in at least
one of claims 11 to 18,
35 characterized in that
each laser diode bar and the associated bridging

P2002,1105 DE E

DE 102 61 309.5

- 11 -

element are applied on a common heat sink, in that the bridging element is fixed on the heat sink by means of a first connecting means and the laser diode bar is fixed on the heat sink by means of a second connecting means, and in that the melting point of the first connecting means is at a higher temperature than that of the second connecting means.

20. The circuit arrangement as claimed in claim 19, characterized in that the first connecting means is a hard solder and the second connecting means is a soft solder.

Abstract

Laser diode component and electronic circuit arrangement comprising a plurality of laser diode bars connected up in series with one another

What is specified is a laser diode component comprising a laser diode bar on which a specific operating voltage is impressed during operation and with which a bridging element is connected in parallel, which bridging element is in a current-blocking state when the specific operating voltage is impressed on the associated laser diode bar and which bridging element changes over to a current-conducting state as soon as the voltage drop across the laser diode bar exceeds the operating voltage by a predefined voltage value. A circuit arrangement comprising a plurality of such laser diode components which are connected in series is furthermore specified.

Figure 1